Optimizing large area fabrication of printed nanolayers for Organic Electronics by In-Line Metrology

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The optoelectronic and charge transport properties of printed semiconductor nano-layers for Organic Electronics-OEs (e.g. polymer donors and acceptors, luminescent polymers) is mainly controlled by the structural morphology and crystallization dynamics during their fabrication in functional OE device architectures. Despite the numerous advances reported on the structure-property relationships on these materials by lab-scale solution-based methods, their reliable manufacturing on flexible substrates by large scale roll-to-roll (R2R) printing processes is accompanied by numerous challenges, such as the formation of structural inhomogeneities and defects, and non-reproducible performance over large areas. These challenges can provide significant obstacles for R2R printing to meet the requirements for reliable large-scale manufacturing of high-performance OE devices on flexible substrates for commercial applications.

In this presentation, we will provide an overview of the main factors that affect the optoelectronic performance and the large area homogeneity of printed photoactive nanolayers (such as PBDB-T, BTP-12, PPDT2FBT) in binary and ternary configurations, on flexible substrates. Moreover, we present the valuable contribution of intelligent in-line metrology (optical, electronic, structural) to understand the formation mechanisms, blend morphology and the factors for defect formation. Finally, we report how we can extract from single optical in-line measurements, useful information about the nanolayer quality, structure and morphology. By this approach, we demonstrate an optimized fabrication process of fully printed large scale flexible OE devices with improved charge transport properties and performance and significant device-to-device reproducibility. [1,2]

References

[1] EU H2020 Project RealNano (www.realnano-project.eu)
[1] EU H2020 Project MUSICODE (www.musicode.eu)

[1] Watson and Crick, Nature **171**, 737 (1953).